National Fenestration Rating Council

National Fenestration Rating Council Incorporated

NFRC 200-2001
Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

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Foreword

This procedure has been developed by the National Fenestration Rating Council (NFRC) to meet the need for a uniform and accurate means for calculating Solar Heat Gain Coefficients (SHGC's) and Visible Transmittances (VT) of fenestration products. The SHGC is determined in accordance with ISO/FDIS 15099 (September 2001), except where noted, at a fixed set of environmental conditions and for normal incidence radiation. Consequently, the SHGC calculated using this procedure may not be appropriate for determining peak solar heat gains for other angles of direct beam incidence, nor for determining the solar heat gain produced by diffuse radiation incident on the fenestration system, nor for determining seasonal energy performance. The VT is also determined for normal incidence direct beam radiation and may not be appropriate for determining daylighting impacts or view through a fenestration product at other angles of incidence.

Consumers today have many new energy-saving fenestration product options to choose from. Advances in fenestration product technologies include the use of low-emissivity coatings, selective tints, insulating spacers, and new frame materials and designs. While the use of one or more of these components can improve fenestration product thermal performance it will also increase the complexity of the selection process. This procedure is offered as a uniform means to calculate total fenestration product SHGC's and VTs for the class of fenestration products that lend themselves to this calculation. It is hoped that in the future, the scope of this calculation procedure can be extended to include an even greater variety of fenestration products.

This document supercedes and replaces NFRC 200 (rev. July 15, 1997). This document contains the state-of-the-art procedure at the time of its publication. This procedure will be updated as new research results become available and accepted. This is a metric document; inch-pound units are for reference only.

Questions on the use of this procedure should be addressed to:

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1.0 Purpose

To specify a method for calculating Solar Heat Gain Coefficient (SHGC) and Visible Transmittance (VT) at normal (perpendicular) incidence for fenestration products containing glazings with specular optical properties in accordance with ISO/FDIS 15099 (September 2001), except where noted.

Note: This standard specifies a method for calculating the solar heat gain and visible transmittance from direct solar radiation through most fenestration products at normal incidence only. This procedure is limited to normal incidence calculations because solar optical data needed for such calculations is typically only available at normal incidence. While solar radiation rarely enters a fenestration product at normal incidence, solar heat gain coefficients and visible transmittance at near normal angles of incidence (less than 30 degrees off normal) are typically very similar to those at normal incidence; for other angles, the solar heat gain coefficients and visible transmittance at normal can be used, to first order, as an indicator of the relative magnitude of solar heat gain and visible transmittance.

2.0 Scope

2.1 Fenestration Products Covered by NFRC 200

(a) Products of all frame materials including but not limited to aluminum, steel, thermally broken aluminum, wood, vinyl, reinforced vinyl, fiberglass, and plastic, used independently or in combination;

(b) Products of all operator or unit types including but not limited to vertical sliding windows, horizontal sliding windows, casement windows, projecting windows, fixed windows, non-standard shaped windows, glazed wall systems, glazings for site built fenestration products, garden or greenhouse windows, bay or bow windows, and skylights;

(c) Single or multiple assemblies of exterior doors;

(d) Products of any size;

(e) Products of all glazing materials, tints, and types such as but not limited to clear glass, tinted glass, laminated glass, thin plastic films (internally suspended, internally applied, or externally applied), rigid plastics with or without any solar control, low-E or any other partially transparent coating;

(f) Products with any or no gap width between glazing layers;

(g) Products with any gas-fill between glazing layers such as but not limited to air, argon, krypton, CO_2, or mixes of these gases.

(h) Products with any spacer or spacer systems between glazings, such as but not limited to metallic, non-metallic, or composite spacers;

(i) Products utilizing any and all glazing dividers, such as but not limited to interior, exterior, or between glazing grilles, muntin bars, true divided lites, or simulated divided lites;

(j) Products designed for installation at any tilt;

2.2.1 Fenestration Products and Effects Covered by NFRC 200 for SHGC

Products not covered by NFRC 200 simulation techniques and which are covered by test only procedure per NFRC 201.

(a) Products with shading systems, between the glazing of the fenestration aperture;

(b) Products with non-specular transmittance and reflectance properties such as, but not limited to, translucent fiberglass and glass blocks; and

(c) Fenestration systems whose glazings depart from being parallel, such as with curved glazing, complete bay windows, corrugated or patterned glazing, glazing blocks, etc. (Fenestration systems made up of combinations of complete windows or doors each of which individually meet the requirements in Section 2.1can be included by treating each of the windows or doors separately)

2.2 Fenestration Products and Effects Not Covered by NFRC 200 for SHGC

It is the intent of this procedure to add the following products to the scope once a solar heat gain test procedure and/or advanced calculation methods have been developed. This may be accomplished through the issuance of a technical interpretation, addendum, and/or by a revision to this document.

(a) Products with shading systems, attached to the inside or outside of the fenestration aperture;

(b) Garage doors with or without glazed areas;

(c) Solar heat gain performance changes of a fenestration product over the course of time, i.e., long-term energy performance;

(d) Fenestration systems with angular selectivity, that is with optical properties, though specular on the small scale, which produce emerging rays whose angle of transmittance is not equal to the angle of incidence, measured with respect to the normal to the plane of the fenestration aperture; and

(e) Chromogenic products whose properties vary, such as electrochromic, thermochromic and photochromic glazing.

(f) Tubular Daylighting Devices

2.3 Fenestration Products and Effects Not Covered by NFRC 200 for VT

It is the intent of this procedure to add the following products to the scope once a visible transmittance test procedure and/or advanced calculation methods have been developed. This may be accomplished through the issuance of a technical interpretation, addendum, and/or by a revision to this document.

(a) Products with shading systems, either between the glazing or attached to the inside or outside of the fenestration aperture;

(b) Garage doors with or without glazed areas;

(c) Visible transmittance performance changes of a window over the course of time, i.e., long-term energy performance;

(d) Products with non-specular transmittance and reflectance properties such as translucent fiberglass and glass blocks;

(e) Fenestration systems whose glazings depart from being parallel, such as with curved glass, complete bay windows, corrugated or patterned glass, glass blocks, etc. (Fenestration systems made up of combinations of complete windows or doors each of which individually meet the requirements in Section 2.1can be included by treating each of the windows or doors separately);

(f) Fenestration systems with angular selectivity, that is with optical properties, though specular on the small scale, which produce emerging rays whose angle of transmittance is not equal to the angle of incidence, measured with respect to the normal to the plane of the fenestration aperture; and

(g) Chromogenic products whose properties vary, such as electrochromic, thermochromic and photochromic glazing.

(h) Tubular Daylighting Devices

3.0 Terminology

3.1 **Solar Heat Gain Coefficient** (SHGC): the ratio of the solar heat gain entering the space through the fenestration product to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and that portion of the absorbed solar radiation which is then reradiated, conducted, or convected into the space.

(a) **Frame Solar Heat Gain Coefficient** ($SHGC_f$): the solar heat gain through all frame and sash members divided by the total incident solar radiation and the frame area, as defined in Section 3.9.

(b) **Divider Solar Heat Gain Coefficient** ($SHGC_d$): the SHGC representative of the divider area, as defined in Section 3.5.

(c) **Edge-of-glazing Solar Heat Gain Coefficient** ($SHGC_e$): the SHGC representative of the edge-of-glazing area, as defined in Section 3.6.

(d) **Edge-of-Divider Solar Heat Gain Coefficient** ($SHGC_{de}$): the SHGC representative of the edge-of-divider area, as defined in Section 3.7.

(e) **Center-of-glazing Solar Heat Gain Coefficient** ($SHGC_c$): the SHGC representative of the center-of-glazing area, as defined in Section 3.8.

(f) **Total fenestration product Solar Heat Gain Coefficient** ($SHGC_t$): the SHGC representative of the total fenestration product, as defined in Section 5.2.3, Equation 1.

(g) **$SHGC_0$:** the total fenestration product Solar Heat Gain Coefficient for a center-of-glazing Solar Heat Gain Coefficient of 0.0.

(h) **$SHGC_1$:** the total fenestration product Solar Heat Gain Coefficient for a center-of-glazing Solar Heat Gain Coefficient of 1.0.

(i) **Frame absorptance:** the fraction of solar radiation absorbed by the exterior frame surface

(j) **Frame color:** the color of the exterior frame surface exposed to solar radiation. See frame absorptance

3.2 Visible Transmittance (VT): the ratio of the visible light entering the space through the fenestration product to the incident visible light. The visible light entering a space is weighted by the photopic response of the eye (refer to NFRC 300).

(a) **Frame Visible Transmittance** (VT_f): the visible light through all frame and sash members divided by the total incident visible light and the frame area (as defined in Section 3.9).

(b) **Divider Visible Transmittance** (VT_d): the VT representative of the divider area, as defined in Section 3.5;

(c) **Edge-of-glazing Visible Transmittance** (VT_e): the VT representative of the edge-of-glazing area, as defined in Section 3.6; the value equals the center-of-glazing VT.

(d) **Edge-of-Divider Visible Transmittance** (VT_{de}): the VT representative of the edge-of-divider area, as defined in Section 3.7; the value equals the center-of-glazing VT.

(e) **Center-of-glazing Visible Transmittance** (VT_c): the VT representative of the center-of-glazing area, as defined in Section 3.8.

(f) **Total fenestration product Visible Transmittance** (VT_t): the VT representative of the total fenestration product, as defined in Section 5.2.3, Equation 2.

(g) **VT_o:** the total fenestration product visible transmittance for a center-of-glazing visible transmittance of 0.0.

(h) **VT_1:** the total fenestration product visible transmittance for a center-of-glazing visible transmittance of 1.0.

3.3 Frame and sash: any structural member of the fenestration product, with the exception of muntins or other dividers used to create true or artificial divided lites.

3.4.1 Projected fenestration product area (A_{pf}): the area of the rough opening in the wall or roof, for the fenestration product, less installation clearances.

***[Note:** Where a fenestration product has glazed surfaces facing in only one direction (typical products), the sum of the edge-of-divider area, the edge-of-glazing area, the divider area, the center-of-glazing area, and the frame area will equal the total projected fenestration product area (A_{pf}). Where a fenestration product has glazed surfaces in more than one direction (e.g., greenhouse/garden, bay/bow windows) the sum of the areas will exceed the projected fenestration product area. (See Figures 1 and 2 in NFRC 100)**]*

3.5 Divider area (A_d): the projected area in the plane(s) parallel to the fenestration product's glazing of all internal, external, or between glazing dividers (includes dividers for simulated or true divided lites, interior and exterior decorator grilles, and between glass muntin bars *(*See Figures 1 and 2 in NFRC 100].

3.6 Edge-of-glazing area (A_e): all glazed vision areas within 63.5 mm (2.5 in.) of any part of the frame and sash or of the door lite frame sight line, excluding any divider or edge of divider. (See Figures 1 and 2 in NFRC 100)

3.7 **Edge-of-Divider area** (A_{de}): all glazed vision areas within 63.5 mm (2.5 in.) of any part of a divider area. The edge-of-divider area shall exclude any edge-of-glazing area contained within the above defined area. (See Figures 1 and 2 in NFRC 100)

3.8 **Center-of-glazing area** (A_c): all glazed areas except those within 63.5 mm (2.5 in.) of any part of a primary sash and/or frame and/or divider; or any part of a primary door and/or frame and/or divider. (See Figures 1 and 2 in NFRC 100)

3.9 **Frame area** (A_f): the projected area of frame and sash in the plane(s) parallel to the glazing surface, - except for doors, which shall include the projected areas of the door jambs, header, threshold, door bottom sweep and the peripheral structural elements of the door leaf, in a plane parallel to the door core surface.

3.10 **Total fenestration product:** the total fenestration product, which includes all frame, divider, edge-of-glazing, edge-of-divider, and center-of-glazing areas.

3.11 **Lite:** Another term for a pane of glass used in a fenestration product. Frequently spelled "lite" in industry literature to avoid confusion with "light", as in "visible light'."

3.12 **Laminated Glass:** An assembly consisting of two or more lites of glass, conforming to Specification C 1036 or C 1048 that are bonded together by interlayer material (ASTM C1172)

3.13 **Interlayer:** a layer of material acting as an adhesive between plies of glass which adds additional performance to the finished product, for example, impact resistance, solar control, acoustical insulation. (ASTM C1172)

4.0 Product Lines and Individual Products

4.1 **Product line:** refer to NFRC 100 for the definition of a product line.

4.2 **Individual Product:** refer to NFRC 100 for the definition of an Individual Product. For the purposes of this procedure only, variations in gap width, frame or sash color, and/or gas fill do not constitute different individual products.

5.0 Standard Conditions & Requirements

This section presents procedures for determining total or component fenestration product Solar Heat Gain Coefficient and Visible Transmittance. For rating Solar Heat Gain Coefficient and Visible Transmittance of individual products at model sizes, follow Section 6, Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance.

5.1 **Computational Procedures**

The total fenestration product Solar Heat Gain Coefficient (SHGC) and Visible Transmittance (VT) shall be evaluated in the position specified in NFRC 100 and in accordance with ISO/FDIS 15099 (ISO 2001), using the fenestration product sizes as given in Section 5.1;. Fenestration product shall be evaluated without screens, removable grilles, or any other applied devices. The items listed below are exceptions to ISO/FDIS 15099 that are to be implemented in NFRC approved software/algorithms:

1) Section 7 on Shading Systems is currently excluded from NFRC procedures.

5.1.1 Approved Center-of-Glazing Computational Program

Approved center-of-glazing software shall be used to determine $SHGC_c$ and VT_c. NFRC approved software is listed in Reference 4. *Approved solar optical data shall be used with the approved center-of-glazing software. NFRC approved solar optical data is listed in reference 4.*

The center-of-glazing Solar Heat Gain Coefficient ($SHGC_c$) shall be determined using the following conditions:

T_{in} = 24 °C (75 °F)
T_{out} = 32 °C (90 °F)
V = 2.75 m/s (6.15 mph)
$T_{rm,out}=T_{out}$
$T_{rm,in}=T_{in}$
I_s=783 W/m^2 (248 Btu/hr-ft^2)

5.1.2 Approved 2-D Heat Transfer Computational Program

Approved 2-D heat-transfer software shall be used. NFRC approved software is listed in Reference 4. Determination of frame U-Factors for calculating frame SHGC shall comply with the conditions of NFRC 100.

5.1.3 Approved Total Fenestration Product SHGC and VT Calculation Procedure

The total fenestration product SHGC and VT shall be calculated as outlined below:

(a) Determine all of the following, as applicable:

(1) Center-of-glazing SHGC and VT using the approved center-of-glazing computational program;

(2) Edge-of-glazing SHGC and VT, equal to the center-of-glazing SHGC and VT values respectively;

(3) Frame and divider SHGC's shall be calculated in accordance with ISO/FDIS 15099 (ISO 2001) Section 4.2.2. The alternate approach in section 8.6 (ISO/FDIS 15099 (ISO 2001) shall not be used. [Note: current research is aimed at assessing which method is more accurate; at some point in the future, this recommendation may be revised.]

Frame and divider SHGC shall be calculated with a default frame and divider absorptance of 0.3 for all products except window glazed wall, sloped glazing systems as defined in Table 1 of NFRC 100, curtain wall and store front as defined in NFRC 100-part II (Site-Built). For these products use a default frame and divider absorptance of 0.5. The frame and divider U-

Factors shall be determined with the 2-D heat transfer computational program at the environmental conditions specified in *NFRC-100, except as noted in section 6*).

(4) Opaque frame and divider VT are equal to 0.0.

(5) Divider edge-of-glazing SHGC and VT, equal to the center-of-glazing SHGC and VT values respectively;

(6) The component areas:
- Center-of-glazing area
- Divider area
- Edge-of-glazing area
- Edge-of-divider area
- Frame area
- Projected fenestration product area.

(b) Perform the following calculations as shown in Equation 1 to determine SHGC:

(1) Multiply all fenestration component SHGC, the center-of-glazing, edge-of-glazing, divider, edge-of-divider, and frame SHGC by their corresponding areas;

(2) Total these quantities; and

(3) Divide this total by the projected fenestration product area to produce computed total fenestration product SHGC for all the fenestration products in the matrix of required SHGC (see Section 6.0).

$$SHGC = \left[\left(SHGC_f * A_f\right) + \left(SHGC_d * A_d\right) + \left(SHGC_e * A_e\right) + \left(SHGC_{de} * A_{de}\right) + \left(SHGC_c * A_c\right)\right] / A_{pf}$$

[Equation 1]

Where:

SHGC	=	Total Product SHGC
$SHGC_f$	=	Frame SHGC-value
A_f	=	Frame Area
$SHGC_d$	=	Divider SHGC
A_d	=	Divider Area
$SHGC_e$	=	Edge-of-Glazing SHGC
A_e	=	Edge-of-Glazing Area
$SHGC_{de}$	=	Edge-of-divider SHGC
A_{de}	=	Edge-of-divider Area
$SHGC_c$	=	Center-of-Glazing SHGC
A_c	=	Center-of-Glazing Area
A_{pf}	=	Projected Fenestration Product Area

(c) Perform the following calculations as shown in Equation 2 to determine VT:

(1) Multiply all fenestration component VT, the center-of-glazing, edge-of-glazing, divider, edge-of-divider, and frame VT by their corresponding areas;

(2) Total these quantities; and

(3) Divide this total by the projected fenestration product area to produce computed total fenestration product VT for all the fenestration products in the matrix of required VT (see Section 6.0).

$$VT = \left[\left(VT_f * A_f\right) + \left(VT_d * A_d\right) + \left(VT_e * A_e\right) + \left(VT_{de} * A_{de}\right) + \left(VT_c * A_c\right)\right] / A_{pf}$$

[Equation 2]

Where:

VT	=	Total Product VT
VT_f	=	Frame VT-value
A_f	=	Frame Area
VT_d	=	Divider VT
A_d	=	Divider Area
VT_e	=	Edge-of-Glazing VT
A_e	=	Edge-of-Glazing Area
VT_{de}	=	Edge-of-divider VT
A_{de}	=	Edge-of-divider Area
VT_c	=	Center-of-Glazing VT
A_c	=	Center-of-Glazing Area
A_{pf}	=	Projected Fenestration Product Area

5.2 This section intentionally left blank.

5.3 Alternative Test Procedure

The component or total fenestration product SHGC shall be tested in accordance with NFRC 201.
The component or total fenestration product VT shall be tested once a test procedure has been approved.

6.0 Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance

This section presents the method for determining individual product SHGC and VT for model sizes.

6.1 Simulation Procedure for Total Fenestration Product SHGC and VT for Model Sizes

Calculation of SHGC and VT for each Individual Product is not necessary. Use the following approach to calculate the SHGC and VT for individual products within a Product Line:

6.1.1 Simulation Procedure:

(a) Identify product groupings within a product line with respect to frame differences. Refer to NFRC 100, Section 1.4.4 and 3.3, for simplifications to a product line. Determine representative frame U-Factors for a group from the existing U-factor matrix. Use the frame option with the highest frame and edge U-factor for the lowest center-of-glazing U-factor in the matrix. The frame SHGC is determined using this frame U-factor (refer to section 5.1.3) and applies to all glazing options in the product grouping, regardless of the number of glazing layers, gap thicknesses, gas fills, and spacer type.

(b) Within the frame groupings, identify divider groupings, if any (refer to NFRC 100 sections 1.4.4 and 3.3 for simplifications to a product line). Assume a default divider U-factor of 2.27 W/m^2-°C (0.4 Btu/hr-ft^2-°F) for all dividers, regardless of type of divider or size, including caming. The divider SHGC is determined using this divider U-factor (refer to section 5.1.3) and applies to all glazing options in the product grouping, regardless of the number of glazing layers, gap thicknesses, gas fills, and spacer type. Separate dividers into two categories: those less than 25.4 mm (1") wide and those greater than or equal to 25.4 mm (1") wide. Dividers greater than or equal to 25.4 mm (1") are modeled at 38.0 mm (1.5") and dividers less than 25.4 mm (1.0")" are modeled at 19.00 mm (0.75"). Products with dividers in only a portion of the product are assumed to have dividers in the entire product. For caming, a default width of 8.0 mm (0.313") used. For default divider and caming patterns refer to NFRC 100-2001.

(c) Determine the total fenestration product SHGC and VT values for center-of-glazing SHGC and VT values of 0.0 and 1.0 per Section 5.1.3. for all applicable cases: no dividers, dividers less than 25.4 mm (1.0") wide and greater than or equal to 25.4 mm (1.0") wide, and caming when applicable. Total fenestration product Solar Heat Gain Coefficient and Visible Transmittance shall be determined for the model size shown in Table 1 of NFRC 100.

(d) For any $SHGC_c$, the total fenestration product SHGC can be calculated using the following equation:

$$SHGC = SHGC_0 + SHGC_c * \left(SHGC_1 - SHGC_0\right)$$

[Equation 3]

Where

$SHGC_0$ = the total fenestration product SHGC for the center-of glazing SHGC of 0.0 and

$SHGC_1$ = the total fenestration product SHGC for the center-of-glazing SHGC of 1.0.

Perform the calculations with $SHGC_c$, $SHGC_0$, and $SHGC_1$ values to three significant figures (0.XXX). Report the final SHGC value to two significant figures (0.XX).

(e) For any VT_c, the total fenestration product VT can be calculated using the following equation:

$$VT = VT_0 + VT_c * \left(VT_1 - VT_0\right)$$

[Equation 4]

Where

VT_0 = the total fenestration product VT for the center-of-glazing VT of 0.0 and

VT_1 = the total fenestration product VT for the center-of-glazing VT of 1.0.

Perform the calculation with VT_c, VT_0, and VT_1 values to three significant figures (0.XXX). Report the final VT value to two significant figures (0.XX).

(f) A matrix of center-of-glazing SHGC and VT glazing options specific to the product line shall be created for use in Equations 3 and 4. This center-of-glazing matrix may

include variations in number of glazing layers, glazing types (tints, laminated glass, etc.), and glazing coatings.

For each product line, products may be rated using either: (1) the actual glazing infill assemblies pane thickness; or (2) applicable representative glazing infill pane thicknesses in Table 6.1 for the range of glazing infill pane thicknesses, for that Product Line.

For laminated glass, use only products with 0.764 mm (.030") interlayer thickness and two layers of 3 mm (1/8") glass to represent any combination of glass thickness and interlayer thickness for glass panes with a total thickness less than or equal to 7.1 mm (9/32 in.). For laminated glass with panes having a total thickness greater than 7.1 mm (9/32 in.), use the actual assembly.

Ratings for products with obscured or wired glass and/or stained glass shall be deemed to be equivalent to the ratings for clear glass.

Table 6.1

Range of Glazing Infill Pane Thicknesses Used in Product Line[1] mm (in.)		**Represented by Size mm (in.)**
$x \leq 2.0$	$(x \leq 5/64)$	Actual
$2.0 < x \leq 4.5$	$(5/64 < x \leq 11/64)$	3.0 (1/8)
$4.5 < x \leq 7.1$	$(11/64 < x \leq 9/32)$	6.0 (1/4)
$7.1 < x$	$(9/32 < x)$	Actual

[1] Total pane thickness for laminated glass

6.2 Testing Alternative

If a product cannot be simulated in accordance with Section 5.3, the test procedures in this section shall be used to determine the SHGC and VT of the individual fenestration products: Section 6.2.1 for the center-of-glazing and Section 6.2.2 for the total fenestration product. However, these test procedures shall only be used for the reporting of SHGC and VT if the size conditions in NFRC 100, Section 6.1.2, are met. The only time a product line shall contain tested total fenestration product SHGC and VT is when an accredited simulation laboratory states in writing that it cannot simulate an individual product(s) to a reasonable accuracy by either using the computational procedure or using combination of computational and center-of glazing component test procedure. In addition, the written permission of NFRC is required for products not specifically addressed in this document.

6.2.1 Center-of-Glazing Component Test Procedure

The Center-of-Glazing SHGC shall be calculated in accordance with NFRC 201.

Guidance or the appropriate use of NFRC's approved procedure for Testing for Center-or-Glazing Component Test Procedure for Center-of-Glazing (VT_c) will be published as an addendum to this procedure or as a Technical Interpretation.

6.2.2 Total Fenestration Product Test Procedure

The total fenestration product SHGC shall be calculated in accordance with NFRC 201. Guidance or the appropriate use of NFRC's approved procedure for Total Fenestration product Test Procedure for VT will be published as an addendum to this procedure or as a Technical Interpretation.

6.3 Total Fenestration Product SHGC For Non-Model Sizes

The approved total fenestration product SHGC calculation procedure may be used to evaluate the total fenestration product SHGC for size configurations other than the Model Sizes for purposes other than certification.

7.0 References

[1] National Fenestration Rating Council. *NFRC 100-2001: Procedure for Determining Fenestration Product U-factors,* Silver Spring, MD.

[2] National Fenestration Rating Council. NFRC 300-2001: *Procedure for Determining Solar and Infrared Optical Properties of Simple Fenestration Product*, Silver Spring, MD.

[3] National Fenestration Rating Council. *Simulation Manual*-2001: Silver Spring, MD.

[4] National Fenestration Rating Council. *List of Approved Simulation Programs*. Silver Spring, MD.

[5} ISO/FDIS 15099 (2001): Thermal Performance of Windows, Doors and Shading Devices — Detailed Calculations

NOTES